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The Province of Alberta

PETROLEUM AND NATURAL GAS CONSERVATION BOARD

IN THE MATTER OF THE GAS RESOURCES PRESERVATION ACT

AND IN THE MATTER of a Joint Hearing to determine various questions relating to the proposed Export of Natural Gas from the Province of Alberta.

I. N. McKinnon Esq., Chairman

D. P. Goodall Esq.

Dr. G. W. Govier

Session: SEPTEMBER 10th, 1951.

Volume 1.

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I N D E X

VOLUME 1.

September 10, 1951.

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Adjourned Hearing on the Application of various companies for the export of gas from Alberta, before the Petroleum and Natural Gas Conservation Board, consisting of I. N. McKinnon, Esq., Chairman, Mr. D. P. Goodall, Vice-Chairman and Dr. G. W. Govier, commencing at the Court House, Calgary, on Monday, September 10th, A. D. 1951.

THE CHAIRMAN: Gentlemen, I think the Board know who represents the various companies here but for a matter of record, I think we should have the names again. We will start with in front.

MR. D. P. McDONALD, K.C.: For Westcoast Transmission Company Limited.

MR. G. H. STEER, K.C.: I am for the Canadian Western Natural Gas Company Limited and Northwestern Utilities Limited.

MR. S. B. SMITH, K. C.: I appear, sir, for Prairie Pipe Lines Limited and Prairie Transmission Lines Limited.

MR. J. E. A. MacLeod, K. C.: I appear for McColl-Frontenac Limited and Union Oil of California.

MR. J. C. MAHAFFY, K.C.: I am appearing for Alberta Grid.

MR. H. G. NOLAN, K.C.: I appear for Northwest Natural Gas Company Limited.

MR. M.M. PORTER, K.C.: I appear for Canadian Delhi and Trans-Canada. With me, I have Mr. Glen Turner of British Columbia and Mr. Ross Tolmie of Ontario?

THE CHAIRMAN: Are there any other parties who wish to be represented?

MR. C. E. SMITH, K.C.: I think, Mr. Chairman, whether or not represented by legal counsel, there may be others. I know that the Canadian Gulf Oil Company have advised, since the last meeting of counsel, that they

Adjournment hearing of the Committee on various commissions for the province of Alberta, before the Provincial and Natural Gas Conservation Board, consisting of I. W. Mackinnon, Esq., Chairman, Mr. L. C. Douglas, Vice-Chairman and Mr. W. Quinlan, commencing at the Court House, Calgary, on Monday, September 10th, A. D. 1951.

THE CHAIRMAN: Gentlemen, I think the Board knows who represents the various companies here for a matter of record. I think we should have the names again. We will start with Mr. Lyon in front.

MR. L. E. MCDONALD, K.C.: For Westcoast Transmission Company Limited.

MR. L. H. STEELE, K.C.: I am for the Canadian Western Natural Gas Company Limited and Northwestern Utilities Limited.

MRS. C. E. SMITH, K.C.: I appear, sir, for Prairie Pipe Lines Limited and Trans-Continental Lines Limited.

MR. E. A. MACLEOD, K. C.: I appear for Canadian Fractionating Limited and Union Oil of California.

MR. L. C. DAHARTY, K.C.: I am appearing for Alberta-Grid.

MR. H. H. NOLAN, K.C.: I appear for Northwest Natural Gas Company Limited.

MR. M.M. PORTER, K.C.: I appear for Canadian Delhi and Trans-Canada. Also me, I have Mr. Glen Taylor of British Columbia, and Mr. Alex Taylor of Calgary.

THE CHAIRMAN: Are there any other parties who wish to be represented?

MR. C. E. SMITH, K.C.: I think, Mr. Chairman, whether or not interested in local consumers, there may be others. I speak for the Canadian Gas Company Limited, since the last meeting of counsel, that there

would like to appear before the Board and give the Board the advantage of their information, particularly with regard to reserves and deliverability phases with regard to Pincher and probably other general knowledge of interest to the Board. I do not know whether there is anybody appearing representing Gulf here this morning. They were advised they would probably be put on the agenda after Western, and if there is anybody here, probably he might make himself known. If not, I know they intend to appear.

MR. FENNY: I am with Deep Rock Oil Company. At present we have no presentation but we would like to be registered.

MR. R. MARTLAND, K.C.: Western Pipe Lines, sir.

.....

THE CHAIRMAN: Mr. Steer, I believe we are to hear from you this morning?

MR. STEER: Mr. Brownie.

FRANK AUSTIN BROWNIE, having been duly sworn, examined by Mr. Steer, testified as follows:-

Q Mr. Brownie, as President of Northwestern Utilities Limited and Canadian Western Natural Gas Company Limited, you have had a study made comparing the two companies' estimates that were submitted to the Joint Hearing, and the Board's planning in its report of last January?

A Yes.

Q And that study is represented by these two documents that have been distributed and of which copies have been furnished to the Board?

A That is correct.

THE CHAIRMAN: Which statement do you propose to deal with first?

A We will deal first with the breakdown of the Gas Company Market Estimates.

BREAKDOWN OF GAS COMPANY MARKET ESTIMATES NOW MARKED EXHIBIT 1.

BREAKDOWN OF CONSERVATION BOARD MARKET ESTIMATES NOW MARKED EXHIBIT 2.

Q MR. STEER: Will you explain these two documents, Mr. Brownie?

A Exhibit 1 is entitled "Breakdown of Gas Company Market Estimates", in billions of cubic feet and I think the footnotes pretty well explain the figures. It will be seen that the figures for Canadian Western and Northwestern Utilities were taken from the report dated October 20th, 1950 and broken down to domestic, commercial and industrial by reference to the report dated January 27th, 1950. That later report of January 27th was Exhibit J-1 in the Joint Hearing. The figures are shown for each of the years 1950, 1960, 1970 and 1980 as being representative of the trend and change of the figures. They are also broken down to Canadian Western, Northwestern and Remainder of Province and to domestic, commercial and industrial and the total. In respect to the remainder of the Province, Exhibit J-1 did not deal with those parts of the Province other than the ones served by the Canadian Western and the Northwestern, so it was necessary to find some figures for the remainder of the Province. We simply accepted those shown on the

Board's breakdown as we had no similar figures in our own report. In Note number 2 our estimates as we stated at the time did not provide for extraordinary increased industrialization of the Province due to petrochemical industries, dispersal of industry and other factors. I think that is all I have to say about that analysis, Mr. Steer.

Q Then we will proceed with the next one, Exhibit 2.

A The second sheet contains a breakdown of the Conservation Board Market Estimates as contained in the Interim Report of January 20th, 1951. The figures shown in red represent the breakdown calculated by us. The Board's report was not on exactly the same basis as ours but we tried to break it down in such a way that it could be usefully compared with our work. To do that we had to make some assumptions so that the breakdown might be to a certain extent arbitrary, but the totals are contained in the Board's report. Would you like me to compare the two reports?

Q Yes, will you do that?

A It will be seen in respect to domestic that the figures are very close. For the year 1950 they are the same because we both used the same information. In 1960 the compnnies had a total Provincial domestic requirement of 26.1 billion. The Board had 27.3. 1970, the companies had 30.5 and the Board, 31.2. 1980, the companies' was 35.1 and the Board, 36.2. As will be seen they are quite close throughout the period.

In respect to commercial, there

is a greater difference. As will be seen, the Board's estimates are approximately 30% higher than the companies' in each of the years 1960, 1970 and 1980. In amount, the difference runs from about 5.7 billion in 1960 to 7.3 billion in 1980. Similarly, in the case of industrial the Board's estimate in the years after 1950 run about 40% higher than the companies', exceeding our estimate by 15.5 billion in 1960 and running up to 20.1 billion in 1980.

Q Have you a comment to make on the difference between your estimates of commercial consumption and the Board's?

A Yes. The Board's estimate was made by forecasting population growth and the trend in per capita consumption and combining the two. The Board noted that from 1930 until the present time the per capita consumption, both domestic and commercial, had risen materially. It was also noted that during the period the rise in dommercial consumption per capita was greater proportionately than was domestic. For these reasons the Board projected a continuing and material rise in commercial consumption per capita. The result is that while in 1950 the commercial consumption per capita was about 68% of the domestic the percentage is projected to rise by 1960 to about 88% of domestic.

On examining the figures we find that while this percentage figure has risen materially during the last 20 years, it has remained unchanged during the last 10 years. In other words, the tendency of commercial per capita consumption to approach the domestic figure during the 1930's appears to have stopped, and was

not continued during the 1940's.

It was our experience, particularly in the Edmonton system during the 1930's that domestic establishments could be more readily converted from coal to gas than could commercial establishments. In the case of domestic business the factor of convenience was important. The conversion of commercial establishments depended more on economic factors. The commercial units were using near cheap coal and large numbers of commercial conversions occurred only after a strenuous selling job and also as a result of higher coal prices and lower gas rates. The job of converting from coal to gas is now almost complete.

We have projected, therefore, a lower increase in commercial per capita consumption than did the Board and therefore have a lower answer. We have no reason at this time to change our estimates.

Q Have you a comment to make on the difference with respect to industrial consumption?

A As we pointed out, our estimates of future industrial use made no provision for extraordinary increases due to such things as petrochemical industries, dispersal of industry, etc. Since the date of our estimates there have been numerous developments by way of large industrial users coming to the Province. We are forced, as a result, to adjust upwards our ideas of future industrial consumption. We now consider the Board's industrial estimates to be, if anything, on the low side. We think it quite possible that increased industrialization will make up

the difference between our industrial estimate and the Board's and in addition compensate for what we consider to be an over-generous allowance in the Board's commercial figure.

Q Anything else?

A I should sum it up, I think, Mr. Steer, by saying in conclusion that we accept the Board's total estimates for the reasons given.

CANADIAN WESTERN NATURAL GAS COMPANY LIMITED
and
Breakdown of Gas Company Market Estimates(1)
- MMMCF

		Dom.	Com.	Ind.(2)	Total
1950	Canadian Western	7.3	4.3	9.4	21.0
	Northwestern	8.5	6.4	4.9	19.8
	Remainder of Province(3)	3.0	1.9	2.1	7.0
	TOTALS	18.8	12.6	16.4	47.8
1960	Canadian Western	9.3	5.7	17.4	32.4
	Northwestern	13.3	10.2	12.4	35.9
	Remainder of Province(4)	3.5	2.2	2.4	8.1
	TOTALS	26.1	18.1	32.2	76.4
1970	Canadian Western	10.8	6.6	20.2	37.6
	Northwestern	15.7	12.0	14.6	42.3
	Remainder of Province(4)	4.0	2.5	2.8	9.3
	TOTALS	30.5	21.1	37.6	89.2
1980	Canadian Western	12.3	7.5	23.0	42.8
	Northwestern	18.1	13.9	16.8	48.8
	Remainder of Province(4)	4.7	2.9	3.3	10.9
	TOTALS	35.1	24.3	43.1	102.5

NOTES:

(1) Totals for Canadian Western and Northwestern taken from report dated October 20, 1950 and broken down to Domestic, Commercial and Industrial by reference to report dated January 27, 1950.

Exhibit 1.
Exhibit 2.

(2) Does not provide for extraordinary increased industrialization of the Province due to petro-chemical industries, dispersal of industry, etc.

(3) Figures taken from Conservation Board Interim Report dated January 20, 1951.

(4) Total figures taken from Conservation Board Interim Report and arbitrarily broken down to Domestic, Commercial and Industrial.

(Sept.10/51)

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CANADIAN WESTERN NATURAL GAS COMPANY LIMITED

and

NORTHWESTERN UTILITIES LIMITED

Breakdown of Conservation Board Market Estimates - MMMCF

		Dom.	Com.	Ind.	Total	
1950	Canadian Western	7.3	4.3	9.4	21.0	
	Northwestern	8.5	6.4	4.9	19.8	
	Other	3.0	1.9	2.1	7.0	
	TOTALS	18.8	12.6	16.4	47.8	
1960	Canadian Western	23.8	21.6	45.3	39.9	90.7
	Northwestern				50.8	
	Other	3.5	2.2	2.4	8.1	
	TOTALS	27.3	23.8	47.7	98.8	
1970	Canadian Western	27.2	24.8	51.7	45.5	103.7
	Northwestern				58.2	
	Other	4.0	2.5	2.8	9.3	
	TOTALS	31.2	27.3	54.5	113.0	
1980	Canadian Western	31.5	28.7	59.9	52.2	120.1
	Northwestern				67.9	
	Other	4.7	2.9	3.3	10.9	
	TOTALS	36.2	31.6	63.2	131.0	

Black figures are taken from Conservation Board Interim Report dated January 20, 1951.
Red (underlined above) figures represent a breakdown calculated by Gas Companies.

(Sept.10/51)

THE CHAIRMAN: Does anyone wish to question Mr. Brownie?

Q DR. GOVIER: Mr. Brownie, do you happen to have available the annual per capita figure for commercial which your company enjoyed?

A No, I do not, Dr. Govier. As you remember, we did not work on that basis. We would have to derive something of that nature that I do not have available at the moment. As I recall it now, on second thought, we did try to work out what in effect we had used and I believe for the future it comes up to 16 M.C.F. per capita as against the Board's 21.

Q That is the figure I wanted.

A Yes.

THE CHAIRMAN: I presume, Mr. Steer, that Mr. Brownie will be available again? We would like to question him later after we have had an opportunity to examine his evidence.

MR. STEER: Yes.

MR. McDONALD: Mr. Chairman, on behalf of Westcoast, possibly I should make a statement to the Board as to the evidence that I intend to lead, and also point out the purpose of the amended application which has been filed. Now, since the Joint Hearings the Board has brought down its interim report. In the

report the Board has brought to the forefront the number of problems which face both the export applicants and are of particular importance to the members of the public and the consumers in Alberta. Now, the Westcoast Company has always adopted the attitude that its obligation is not only to deal with its own problems of export but also to relate its application to the requirements and interests of the people of the Province, those terms stated by the members of the Government who have issued indications of policy from time to time, some of which are set out in the interim report itself. Now, the Board in its - -

MR. C.E. SMITH: Mr. McDonald, would you excuse me a moment. I wonder, sir, if Mr. McDonald is speaking of what he refers to as the Amended Application and if all interested parties have had a copy of that?

MR. McDONALD: I was going to distribute it and read it into the record.

MR. C.E. SMITH: Oh.

MR. McDONALD: I can distribute it now and I might continue my statement.

MR. C.E. SMITH: Surely. I just wondered whether or not other people had it, that is all.

MR. McDONALD: Dealing with the report, Mr. Chairman, the report estimates the reserves in

Alberta as of the date of the report, and Westcoast, without agreeing in detail with the conclusions reached by the Board, accepts the conclusions, however, of the Board as to the reserves set out and as to the requirements, of the consumers' requirements, of supplies necessary to protect the consumers in Alberta, and the submissions that will be made will be made on that basis except with respect to some minor details as to production and possibilities, additional possibilities, of gas in one or two of the reserves.

Now, I think, Mr. Chairman, from the point of view of the consumers of Alberta the outstanding finding of the Board is the deficiency that will occur over 30 years on the basis of the Board's estimates of supply and demand in the Province, and one of the main submissions that will be made by this Company will be a plan or plans of meeting the deficiencies that have been set up by the Board.

Now, arising out of that particular problem, the Westcoast has amended its application. I think some of them have been distributed, Mr. Chairman.

THE CHAIRMAN: Mark that as Exhibit 3.

SUBMISSION OF WESTCOAST TRANSMISSION COMPANY LIMITED PUT IN AND MARKED EXHIBIT 3.

MR. McDONALD: I think, Mr. Chairman, it would serve a useful purpose if I read the submission. The application is dated the 23rd of August, 1951.

IN THE MATTER OF THE GAS RESOURCES PRESERVATION ACT

AND IN THE MATTER OF THE APPLICATION OF WESTCOAST TRANSMISSION COMPANY LIMITED AND WESTCOAST TRANSMISSION COMPANY LIMITED (ALBERTA INCORPORATION) FOR A PERMIT AUTHORIZING THE PURCHASE AND SALE OF NATURAL GAS IN THE PROVINCE OF ALBERTA FOR TRANSMISSION TO POINTS IN THE PROVINCE OF BRITISH COLUMBIA AND THE STATES OF WASHINGTON AND OREGON IN THE UNITED STATES OF AMERICA.

AMENDED APPLICATION

TO: THE PETROLEUM AND NATURAL GAS CONSERVATION BOARD
CALGARY, ALBERTA.

The undersigned WESTCOAST TRANSMISSION COMPANY LIMITED, (incorporated by Act of Parliament of Canada), and WESTCOAST TRANSMISSION COMPANY LTD., (incorporated under the laws of the Province of Alberta, hereinafter designated the Alberta corporation), HEREBY MAKE APPLICATION to amend the application hitherto filed by the applicants for a permit or permits authorizing the applicants to purchase

and sell natural gas in the Province of Alberta for the purpose of transmission thereof from the Province of Alberta to points in the Province of British Columbia and the States of Montana, Idaho, Washington and Oregon in the United States of America by substituting this amended application in lieu of the said application.

This amended application is made having regard to the following considerations:

The Interim Report of the Petroleum and Natural Gas Conservation Board dated January 20th, 1951, dealt fully with the problems of meeting anticipated requirements of Alberta consumers of natural gas for a period of thirty years.

The Board estimated, on the basis of the present sources of supply of the Northwestern Utilities System, the total deficiency of supply of gas for the System over thirty years would be 475 billion cubic feet and a peak day deficiency of about 335 million cubic feet per day in the year 1980. At page 47 the Board stated:

> " It, therefore, appears to the Board that further development, quite possibly in the Morinville-Picardville area, or other areas within economic reach, is required to establish the sufficient reserves to meet the system deficits

"contemplated as occurring in the early 1960's. Until such further reserves are established to meet these deficiences the Board cannot declare any gas from the following fields to be surplus to the requirements of the Province:

Bon Accord
Excelsior
Golden Spike
Joseph Lake
Legal
Morinville
Picardville
Provost
Redwater. "

The Board estimated that on the basis of the present sources of supply for the Canadian Western Natural Gas System the total deficiency in the amount of gas required for the System over thirty years would be 600 billion cubic feet and a peak day deficiency of about 230 million cubic feet per day in the year 1980. At page 46 of the Interim Report the Board stated:

" From the point of view of the Canadian Western Natural Gas system the acquisition of the Pincher Creek field to meet its deficiencies does not appear attractive unless it is the only solution of the problem. Operation costs including depreciation would mean expensive gas which no doubt would be discouraging to future

"industrial development.

Similarly from the point of view of the operators of the Pincher Creek field, meeting the deficiencies of the Canadian Western system is not an attractive proposition owing to:

a. the long delay before being able to produce the field;

b. the comparatively low annual withdrawal when production does commence;

c. the low load factor.

Counsel for the City of Calgary in his brief to the Board suggested that if export were not permitted the problem of providing markets for those who have in good faith spent substantial amounts in developing gas for which there is at present no market might be met by provision for sharing the market. If this were done in the case of the Canadian Western Natural Gas system and the market were shares between Turner Valley, Jumping Pound, Pincher Creek, Princess-Patricia, and the Pakowki Lake fields it could only mean very expensive gas when the capital outlays and the operating costs involved are taken into consideration.

What seems to be needed is the development of some further dry gas reserves, the planning of a

"future peak sharing storage project, and the integration of the dry gas reserves, the storage scheme and Pincher Creek to meet jointly the requirements of the Canadian Western Natural Gas system and some export market proportionate to the increase in reserves."

Throughout the various hearings conducted by the Board prior to issuing the Interim Report, counsel for the City of Calgary emphasized that applicants for the export of gas should, as part of their submission, present to the Board a feasible plan which would provide adequate gas supplies for Alberta consumers for a reasonable period at no higher prices than would occur if export was not permitted.

Having regard to the foregoing findings of the Board and the representations of counsel for the City of Calgary, the proposals of the applicants as hereinafter set out are designed to provide:

A. <u>With Respect to Southern Alberta</u>:

1. An economical additional supply of gas for the Canadian Western Natural Gas System sufficient to meet the estimated deficiencies for the system, as calculated by the Board, over a period of thirty years. By developing the Pincher Creek field for a limited

export market a productive capacity sufficient for economic operation of the field can be established so that the increasing quantities of gas required by the Canadian Western Natural Gas System, which cannot be economically obtained otherwise, can be delivered to the System at a minimum cost.

2. By development of the Pincher Creek field substantial quantities of sulphur now urgently required for industrial purposes, particularly defence requirements, together with propanes, butanes and distillate.

3. Returns on a long standing investment to the owners of the gas in the Pincher Creek field.

4. Substantial revenue to the Government of Alberta from royalties on gas, oil and sulphur.

B. <u>With Respect to the Edmonton Area</u>:

1. The reservation of all gas supplies in the north central area of Alberta for consumers on the Northwestern Utilities System and other possible industrial users in the Edmonton area.

That has reference, sir, to the fact that in our prior applications we had a branch line which tapped the Edmonton area. That is now abandoned.

C. <u>With Respect to Northwestern Alberta</u>:

1. Export of gas from Northwestern Alberta, which is not economically accessible to Alberta consumers, to the Pacific Northwest area, the only market for such gas.

2. The development of a gas supply for residents of communities in the Peace River area who otherwise could not be economically served by a gas distribution system, including the town of Grande Prairie and communities adjacent to the pipeline systems constructed by the applicants.

The granting of export permits for gas from northwestern Alberta and the Pincher Creek field as herein applied for will ensure the obtaining of the most economical markets for surplus Alberta gas production, resulting in a well-balanced Province-wide development of Alberta gas resources for the benefit of all sections of the Province.

In support of this amended application the applicants submit:

1. The Westcoast Transmission Company Limited is a Company incorporated by Act of Parliament of Canada, assented to the 30th day of April, 1949. Pursuant to the powers granted in the Act of Incorporation the applicant Westcoast Transmission Company Limited proposes:

a. to construct a pipeline for the transmission

of natural gas from a point in the vicinity of the Pouce Coupe gas field in the Province of Alberta to a point on the boundary between the Province of Alberta and the Province of British Columbia in the vicinity of the Town of Dawson Creek, thence through Pine Pass in the Province of British Columbia to Prince George, thence by Quesnel, Williams Lake, Kamloops, Merritt, Princeton and Hope to a point in the vicinity of Vancouver, including a line from the said point in the vicinity of Vancouver to a point on the International Boundary in the vicinity of the Town of Huntington, where the pipeline of the applicants will connect with a pipeline from the said International Boundary to the cities of Seattle, Tacoma and Portland and vicinity in the States of Washington and Oregon.

b. to construct a pipeline for the transmission of natural gas from a point in the vicinity of Pincher Creek gas field in the Province of Alberta to a point on the boundary between the Province of Alberta and the Province of British Columbia approximately four miles north of the International Boundary, thence through British Columbia to a point on the International Boundary in the vicinity of the Flathead River where the pipeline of the applicants will connect with the pipeline from the said International Boundary to the towns and cities

of Kalispell, Wallis, Kellog, Spokane and vicinity in the States of Idaho and Washington, and the City of Trail and vicinity in the Province of British Columbia.

2. The applicants propose to purchase gas, not otherwise required for the production of oil or for the use of consumers in the Province of Alberta, to supply the pipeline referred to in paragraph 1(a) above from producers of gas in the following fields and areas:

a. Whitelaw area,
b. Pouce Coupe area,
c. Tangent area,
d. Dunvegan area,
e. Belloy area,
f. Normandville area,
g. Any further fields or areas in the Northwestern Alberta area from which gas can be economically delivered to the pipeline or gathering system.

3. The applicants propose to purchase gas, not otherwise required for the production of oil or for the use of consumers in the Province of Alberta, to supply the pipeline referred to in paragraph 1(b) above, from the producers thereof in the Pincher Creek field or area in the Province of Alberta.

4. The Westcoast Transmission Company Ltd. (Alberta corporation) is a Company incorporated under the laws of the Province of Alberta. The Alberta corporation proposes to construct large diameter pipelines required for gathering gas from the fields where the same is produced in the Northwestern Alberta area and transmit the

same to the terminus at Pouce Coupe field of the pipeline to be constructed by Westcoast Transmission Company Limited. The Alberta corporation also proposes to construct transmission lines from its gathering system to the communities in the Peace River area which can be economically served including the town of Grande Prairie.

5. Particulars of the estimates of the said reserves in each of the fields and areas above mentioned and the geological, engineering and other relevant data in respect thereof will be set out in the exhibits to be filed on behalf of the applicants with the Board at the hearings presently being conducted by it which said exhibits are incorporated herein by reference.

6. Particulars of the estimates of the numbers of domestic, commercial and industrial consumers to be supplied by the applicants in the marketing areas above mentioned together with estimates of the maximum hourly peak load, maximum monthly and annual requirements and relevant data as to temperature and load factor, will be set out in the exhibits to be filed on behalf of the applicants with the Board at the hearings presently being conducted by it which said exhibits are incorporated herein by reference.

7. The applicants request a permit authorizing the applicants to purchase in the Province of Alberta

and transmit to the markets hereinbefore mentioned:

(a) a maximum of 70 billion cubic feet of gas annually to the markets in the Province of British Columbia and the cities of Seattle, Tacoma and Portland and vicinity in the States of Washington and Oregon.

(b) a maximum of 25 billion cubic feet of gas annually to Kalispel, Wallis, Kellog, Spokane in the States of Montana, Idaho and Washington, and Trail and vicinity in the Province of British Columbia.

8. The applicants request that the period for which the permit herein applied for shall remain in effect shall not be less than thirty years with respect to the markets mentioned in paragraph 7(a) above, and not less than twenty years with respect to the markets mentioned in paragraph 7(b) above.

9. The applicants respectfully subject themselves to the provision of The Gas Resources Preservation Act and the orders and regulations made or to be made thereunder.

DATED at the City of Calgary, in the Province of Alberta, this 23rd day of August, A.D. 1951.

Respectfully submitted,

WESTCOAST TRANSMISSION COMPANY LIMITED

By: (sgd) Frank M. McMahon

A. P. Bowsher

WESTCOAST TRANSMISSION COMPANY LTD.

By: (sgd) Frank M. McMahon

A. P. Bowsher.

MR. SMITH: Mr. Chairman, might I intervene? Reference has just been made to counsel for the City of Calgary. I should have told the Board at the time of registration that Mr. Fenerty advised me orally two or three days ago, I have forgotten when, that he would not be appearing at this Hearing. I am sure all of the gentlemen may not agree with him always but they certainly miss him, I think.

MR. McDONALD: In respect of the application, sir, I should point out that the witnesses that the Westcoast Company intend to present are as follows: Dr. Nauss will deal generally with the matters of reserves in the Province and with some particularity with regard to the Pouce Coupe area, being the source of supply mentioned in the application for the Westcoast line; Dr. J.F. Dodge will submit evidence in regard to the completion of wells and estimates of gas discovered following drilling of exploration and development wells.

I am advised in addition to the Gulf Company, which contacted Mr. Smith, that there are a number of other producers who have extensive gas holdings throughout the Province and who

are prepared to make representations to the Board. The Hudson's Bay Oil and Gas Company has already prepared a submission and it has been distributed. The Union Oil Company of California has also prepared a submission which will be ready for distribution today. I understand there are other companies which have submissions in the course of preparation. As I understand it, the submissions will deal with the Province as a whole and not the interests, as it were, of any particular applicant here. I would suggest as and when the officers of those companies are available to put the evidence before the Board that they be allowed to put it in.

(Go to page 25)

THE CHAIRMAN: And if they would contact Mr. Smith at that time.

MR. McDONALD: Yes, that will be fine. The reason I mention that, sir, is that I understand there is an officer of the Union Oil Company of California that will be here this week and will not be here next week. The other witnesses to be called will be local managers and can be called at any time. Now, sir, with regard to the question of the availability of the gas to the Canadian Western system and the Northwestern Utilities system, the proposals that have been outlined in the application to meet the deficiencies set up by the Board dealing with the Pincher Creek field and the fields in the vicinity of Edmonton have been prepared by Dr. Hetherington and will be submitted by him. With regard to the additional items such as the engineering, the routes, markets and export requirements, I understood from the Board that these items would stand over for consideration at a second phase of the present hearing. I might say, sir, that that information will be available in the very near future in case the Board wants it sooner than was otherwise anticipated. I would like to call Dr. Nauss, sir. I have quite a number of the brief that Dr. Nauss is going to present, and will give copies to anyone who requires them. I might say, Mr.Chairman, that we have distributed 50 copies at the present time and I will get a few more if there are others that want copies.

This document is entitled "Gas Reserves of the Province of Alberta", prepared by Link & Nauss Limited, and is dated August 25th, 1951. I would

like to have that marked as an exhibit, sir.

THE CHAIRMAN: Exhibit 4.

GAS RESERVES OF THE PROVINCE OF ALBERTA, DATED AUGUST 25th, 1951, BY LINK & NAUSS LIMITED, MARKED EXHIBIT 4.

.....

ARTHUR W. NAUSS, having been first duly sworn, examined by Mr. McDonald, testified as follows:-

MR. McDONALD: I submit, sir, Dr. Nauss has been already qualified before the Board as an expert.

THE CHAIRMAN: Yes.

Q MR. McDONALD: Dr. Nauss,would you read the foreword and the introduction to the report without detailing the reserves that you set out?

A Yes. This is the third report with respect to the gas reserves of Alberta submitted to the Petroleum and Natural Gas Conservation Board on behalf of the Westcoast Transmission Company Limited. The first two reports, namely, Exhibit 3 - Westcoast Hearing Transcript January 30th, 1950, and Exhibit J.29 - Joint Hearing Transcript November 8th, 1950, contained the data available in respect to the wells completed in the Province up to the date of each such report. Data previously submitted om the first two reports is not reproduced herein except where new information has warranted revision of the estimates in respect to any particular field. In this report there is set out in the tables contained in plates 2, 3, 4 and 5 the data used in respect to the reserve calculation in each field in the Province. These tables

are a continuation of the tables furnished with our previous reports referred to as Table "A" and Table "A" Revised.

Based on the data set out in the two previous reports and set out herein the recoverable gas reserves of Alberta at the present time are estimated to be 7,811.1 billion cubic feet. This estimate includes all areas for which sufficient information is available on all geological horizons.

The recoverable gas reserves of the area within one hundred miles of Edmonton are estimated to be 2,892.4 billion cubic feet; incidentally, that figures includes the Provost field which is more than one hundred miles from Edmonton, but which is within 65 miles of the Northwest Utilities' pipeline. Those of the area which could economically supply the City of Calgary are estimated to be 3,835.6 billion cubic feet.....

Q Just a moment, Dr. Nauss, there is a correction that you have read in there?

A Yes.

Q The words "within one hundred miles of Calgary" are deleted?

A In this area there are quite a number of fields that are quite a lot farther from Calgary than one hundred miles.

MR. SMITH: What was that correction?

MR. McDONALD: The words "within one hundred miles" are deleted. And the wording that you used was what, Dr. Nauss?

A "Which could economically supply the City of Calgary."

Q Which could economically supply the City of Calgary?

A Yes.

MR.SMITH: I just wanted to follow it.

A ...and those in the Peace River area including the Sunrise and Pouce Coupe fields in British Columbia to be 1,026.8 billion cubic feet. The remainder of Alberta is estimated to contain 112.8 billion cubic feet of recoverable gas reserves.

This report also includes a Summary of the exploration drilling and a discussion of the stratigraphy of the Peace River area and the prospects of establishment of the gas reserves required for supplying the export markets now available in British Columbia and the Pacific Northwest States.

Following the method used in compiling the two previous reports the data used in the compilation of the estimates presented herein were obtained from nearly all the Oil Companies now active in exploration in Alberta, the Petroleum and Natural Gas Conservation Board, and other presentations to the Board of a similar nature. The reports by the Canadian Geological Survey on Natural Gas Reserves of the Prairie Provinces by G. S. Hume and A. Ignatieff were also used extensively.

The reserve estimates were calculated by the volumetric or porosity-area method except where addditional reservoir pressure decline data were available. All available geologic information, including electrologs, micrologs, cores, samples, drillstem tests, flow tests and production histories, were used in the calculations. In many cases where one well encountered a thick gas sand, an arbitrary figure of 2,000 acres for the area was again used. This means that the well proves

a gas reserve in the surrounding 2,000 acres, the boundaries of the acreage not necessarily being equidistant from the well . We have chosen this method in preference to drawing assumed contours with only one point for control.

The reserves were calculated to gas in place in the reservoir at standard conditions, i.e., 14.4 p.s.i.a. and 60°F. and a recovery factor was used to estimate the recoverable reserves. The recovery factor takes into consideration that amount of gas still in place after the reservoir is exhausted and probable surface losses.

Q Just a moment, Dr. Nauss. At the top of page 2 you have "the recovery factor includes that amount of gas still in place after the reservoir is exhausted and probable surface losses." For clarity you think that should be written "recovery factor takes into consideration"?

A Yes, I think that is a better word.

Q That is instead of the word "includes"?

A Yes. We will explain that again.

MR.SMITH: So long as we follow what is read.

Q You might point out the difference in your Tables set out, Dr. Nauss, on Tables 2, or Plates 1, 2, 3, 4 and 5?

A This Table is similar to Table "A", the main difference being that the column headed "Reserves at 14.4 pounds per square inch" is gas in place, where previously we have in that column "Gas Reserves to an Abandonment Pressure" usually 100 pounds. In the previous report we calculated reserves to 100 pounds in order to enable a comparison to be made with Dr. Hume's report. Dr. Hume has now changed

his system in his final report, so that we have used the more fundamental figures of gas in place and have taken a recovery factor. Now, that recovery factor takes into consideration not only the gas left in the reservoir but other surface losses, and is essentially the same in amount as the percentages used in our first Table.

Q MR. STEER: These four pages following page 5?

MR. McDONALD: Yes.

MR. STEER: These Plates 2, 3, 4 and 5, are they?

MR. McDONALD: That is right, Mr. Steer.

Q Just dealing with that so that it will be clear to the Board and others interested, Dr. Nauss, when we come to calculate deliverability and deal with the question of production of the gas, the fundamental figure is the reserves in place?

A The reserves in place is one of the figures used...

Q Yes?

A ...in the formulas for calculating deliverability.

Q And the matter of production down to 100 pounds abandonment pressure was apparently or purely a figure that was used as a comparative figure rather than being useful from an engineering standpoint?

A Yes, it had no great usefulness from an engineering standpoint.

Q Now, then, just so that we will sure what your discount factor is, or your shrinkage factor, take the first item, the Acheson Field, that is the top of Plate 2.

MR. SMITH: You hit a good example there,

according to the newspapers, Mr. McDonald.

MR. McDONALD: I have not read the paper this morning yet.

Q You take 80% as your recoverable?

A Yes.

Q And the balance of 20% you have discounted in order to take care of losses in the reservoir?

A The larger amount of that 20% would be the amount left in the reservoir, and there would be further losses due to shrinkage and to other surface losses.

Q And what you include in that is the discount factor referred to by the Board in its report dealing with the same subject?

A Yes. In the previous hearing we presented a breakdown of what that would include, and no change has been made. It still includes the items we gave in the previous hearing.

Q With the item of reserve left in the ground?

A Yes. The only change is that the amount left in the ground at abandonment pressure is included in the 20% discount factor.

Q Then to recapitulate, the shrinkage includes the gas losses in the ground, left in the ground, plus all losses on the surface in the nature of shrinkage and lease loss?

A The per cent under recoverable, the difference between this and 100% includes all losses in the reservoir and the surface losses, yes, in addition to shrinkage.

Q If you will go on at page 2, please?

A The recoverable reserves for the entire Province amount to 7,811.1 billion cubic feet of gas. This can be divided up as follows:

Calgary area	3,835.6	billion	c.f.
Edmonton area	2,892.4	"	"
Peace River area	980.3	"	"
Remainder of Alberta	102.8	"	"

The following is a list of the fields in the various areas with their reserves.

Edmonton Area

Wells drilled since the last estimate of gas reserves was made have enlarged some fields and reduced others. A list of new gas wells, data obtained from them and a re-calculation of the gas reserves on the basis of the new information is included with this report.

The following is a list of the gas fields and the recoverable reserves in the area....

Q And similarly you have at page 4 the Calgary area, and on Page 5 the Peace River area, with the names and the amount of reserve you attribute to each field?

A Yes, sir.

MR. McDONALD: Mr. Chairman, it is my suggestion that instead of dealing in detail with each of the fields reported on, that Dr. Nauss refer only to those that he thinks would be of particular interest and explain briefly the basis of his estimate, and I also suggest that he deal with it on the basis of the Edmonton Area, then the Calgary Area, and then the Peace River Area.

THE CHAIRMAN: Yes.

Q MR. McDONALD: Dealing with the Edmonton Area, starting at page 6, Dr. Nauss, would you just refer briefly to the Acheson-Stony Plain Field, so as to indicate the

method by which you arrive at your estimate?

A Our method of calculating the reserves has not changed, of course. On page 6, the Acheson-Stony Plain Field, there are two reservoirs in that field, the Viking Sand and the Basal Cretaceous Sand. The top of the Viking Sand is 3300 feet. The estimatedarea of production in that sand is 1680 acres. The estimated average thickness of 15 feet. That is the average over the productive area, and it is taken from electric logs and pore descriptions mainly. The estimated average porosity is 18%. And again we do not have porosity determinations, the core analyses for all of these fields. Where we do not have such core analyses we have made an estimate of the porosity. The estimated connate water in the Acheson-Stony Plain area is 30%. The estimated reservoir temperature is 105° Fahrenheit, and the estimated reservoir pressure is 1070 pounds per square inch. The compressibility at reservoir condition .86. The calculation is shown there as a method of arriving at 8.8 billion cubic feet.

Q Now,where you have made estimates of porosity and connate water, you have had regard to the experience throughout the Province in similar types of production?

A We have given consideration to whether it was a limestone or a sand, and the quality of that sand in order to estimate the porosity.

Q You have the location of the Acheson-Stony Plain field. That is fairly close to Edmonton, is it not?

A The Acheson-Stony Plain field is about 6 or 8 miles West of Edmonton. The main highway runs right through it.

Q You have following plate 4 plate 5, which is a map of gas fields in the Edmonton area?

A Yes, on this map it shows the gas fields within a hundred miles of Edmonton. The gas fields are shown in green on that map and the oil and gas fields are shown in Brown. Leduc, Redwater, Joseph Lake, Duhamel and Golden Spike, etc. They are all shown in brown on the map. The map extends from just south of the Stettler area north to Athabasca and as far east as the Viking-Kinsella field. The furthest west gas field is Chip Lake.

Q Now dealing with the fields in order. Most of these fields, the production is obtained from what formation?

A Most of the new discoveries in the past six months to date have been in the Viking and Lower Cretaceous in the Edmonton area. A very large number of wells hit gas in the Viking or Lower Cretaceous and that is the Basal Quartz Sand or Glauconitic Sand in the Lower Cretaceous that gas is usually encountered in.

Q That is true except for one location, that is Majeau Lake?

A At Texaco Majeau Lake No. 2. . .

Q Just a moment. That is at page 25 of the report. Would you deal in detail with the Majeau Lake reserve?

A The location of the Majeau Lake field can be seen on the index map of gas fields in the Edmonton area. It is approximately 65 miles North West of Edmonton, and the

detailed map is shown following page 25, the detailed map of the area which shows the surrounding wells. You will note it is about 20 miles South East of the Barrhead area where some gas and oil was discovered in the Madison. Texaco-Majeau Lake No. 1 is in Legal Subdivision 3, Section 25, Township 56, Range 4 and encountered large flows of gas with some distillate in the Madison formation and gas in the Viking. The well data is listed there and the drill stem tests. I will go through these drill stem tests. The first drill stem test was from 3483 to 3526. That was in the top of the Viking zone and there was a gas flow of 112 Mcf per day. The next test was from 3531 to 3556. That was also in the Viking. No gas was recovered. So the flow in the Viking was small. The next test was from 4196 to 4215. That was in the top of the Madison. It was 5 feet into the Madison. The top was at 4210 and the bottom of the test was 4215. They encountered 4 million cubic feet per day and some naphtha. The next test was from 4209 to 4217. That test also got a very large flow, 5614 Mcf per day and no water. The third test in the Madison was from 4207 to 4223. There was a gas flow but we do not have the measure of that gas flow, only 10 feet of mud was recovered. The fourth test was from 4219 to 4231. Gas flow of 4215 Mcf per day was obtained and 90 feet of oil-cut salt water was obtained on that test. The bottom test was 21 feet into the top of the Madison. They went on and tested further another 10 feet and got a gas flow of which we do not have the data. There was some naphtha in that test but no salt water. From 4239 to 4251, another ten feet, they got a gas flow of 539 Mcf per day

and recovered 95 feet of mud. Then they went ahead and tested another 20 feet at 4249 to 4271 and got a gas flow of 700 Mcf per day with 20 feet of salty mud and water. Then they went ahead and tested from 4270 to 4301 and got a gas flow of 1080 Mcf per day,recovered 25 feet of black oil and 50 feet of salt water. The amount of salt water is very small. You will notice the total thickness of the test was 91 feet from the top of the Madison. There is no way that we can know the area. We have not seen a seismic map of the area. We have taken 2000 acres. It could be much larger than that. The reserves amount to 10 million cubic feet per acre, giving a total reserve of 20 billion cubic feet.

Q You have used a recovery factor on that of 70%?

A The reason for the lower recovery factor is the content of naphtha. The shrinkagewill be larger.

Q Do you have a core analysis or connate water analysis?

A No, we do not have a core analysis on it.

Q Your estimate of porosity 10%, is that a reasonable estimate for Madison production?

A We think so. We have used a thickness of 40 feet, a net pore thickness amounting to 40 feet.

Q Yes, and Madison is a formation from which a great deal of the gas production in the Province is obtained?

A Yes, it is. It produces at Pincher Creek, Turner Valley, Jumping Pound and quite a number of other areas. This is one of the more important discoveries of the last few months in the Edmonton area in our opinion.

Q MR. STEER: Is the gas sweet?

A I do not have an analysis of the gas. I believe it would not be. I believe there will be some sulphur.

Q MR. McDONALD: You have taken that into account in your 70% factor?

A Yes.

Q Do you want to discuss the Manawan Lake area before you come to Morinville?

A At Manawan Lake an additional well was drilled. In this Table A we have called this area the Bailey-Long Island and an additional well Eldon No. 1 was drilled one mile South and encountered gas, and in addition to encountering gas in the same horizon as the Bailey-Long Island, an additional reservoir sand a few feet higher in that section was encountered, so we have had to revise the reserves upwards. The total recoverable reserve is 32.4 billion in the Basal Quartz and 5.1 billion in the Glauconitic Sand.

Q Now you come to the Morinville area. You have a map of the Morinville area, which is preceding page 29 and you have a discussion of additional drilling in that area?

A In the Morinville area we previously connected the wells Morinville Nos. 1 and 2 and Cardiff Giant No. 1 well to Calahoo. In the past six or eight months Imperial drilled a well between those two areas and did not encounter gas in the Basal Quartz sand. So we have had to revise the reserves downward. Some additional gas wells have been drilled in the Eastern part of this area by the Ajax people. They have drilled three wells, one a mile to the South East of Morinville No. 1, one approximately a mile to the North West of Morinville No. 2. Both of those were gas wells

and have firmed up the normal reserves in the area shown on that map. Now one dry hole was drilled by the Ajax people about a mile and a half North East of Cardiff Giant No. 1 well. That did not encounter gas in the Basal Quartz Sand, so that is the first well to limit the field on the East. The total area at the present time for Morinville is 11,960 acres and we have given 2000 acres for the Calahoo well, giving a total of 13,960 acres rather than the 39,000 acres as previously reported on in Table A. The estimated reserves of the Morinville area itself, which includes those four wells is 217.4 billion cubic feet of gas.

Q Then the Calahoo area, you have given a calculation for the Calahoo area on page 17?

A The calculation for the Calahoo well alone was an area of 2000 acres, a thickness of 25 feet and recoverable gas, 27.4 billion, giving a total for the two areas of 244.8 billion cubic feet.

Q MR. C. E. SMITH: That is what you call Morinville and Calahoo, is it?

A Yes.

MR. McDONALD: In the previous submission, Mr. Smith, these Calahoo and Morinville fields were combined, with a total of some 39,000 acres. Now they have been separated and the acreage reduced to 13,960.

Q Is there anything else you wish to say about Morinville?

A No, I think that is everything.

Q Then with regard to the Picardville area. There has been additional drilling in the Picardville area since the date of your last report?

A Yes. This map just before page 29 shows the Picardville area. The first well is that shown in section 6 in the North West corner of the map. That was Union-Picardville No. 1 well and since that date the Canadian Delhi No. 1, which is two miles to the South West, was drilled. It was a dry hole.

Q Canadian Delhi-Union No. 2?

A This is the No. 1 well to the South West was a dry hole. Then the second well, Canadian Delhi No. 2, was drilled a mile to the South East and is a gas producer. We have used those two wells and made a calculation amounting to 26.4 billion cubic feet. Since this report was prepared, a third well, Canadian Delhi No. 3 has been completed in Section 4 of Township 59, Range 26, about two miles East of the No. 1 well and it got gas in a different sand of the Viking than in these two. The Viking had several sands in that area and the No. 3 well got gas in a different sand than the first two. That well revised the gas reserves upwards, that third Delhi well.

Q Yes, there would be a great deal more acreage proved up?

A Yes, there will be some more acreage proved up.

Q You have not had an opportunity to consider that or to make a calculation?

A No, we have not.

Q Now, the balance of your estimates deal with one-well discoveries?

A No, there are several others that are not one-well discoveries. There is Amisk Lake area which has several wells in it but most of them are one well. Most of those

new discoveries are one-well, isolated wells.

Q MR. STEER: Can we get the information as to what the gas production was from the No. 3 Delhi?

MR. McDONALD: I was going to suggest that my friends of the Delhi company will have that information available in detail and it would not be necessary for us to produce it.

MR. STEER: Dr. Nauss has not got it?

MR. McDONALD: No, he has not got it.

Q MR. C. E. SMITH: And what was the other area Dr. Nauss mentioned to you?

A Amisk Lake.

MR. McDONALD: That is at page 12.

A The map of the area is shown following page 12. The first well in that area to be drilled or the first gas indicated in that area was Boyle Madison No. 1 and they got on a drill stem test on top of the D-2, they got two or three million cubic feet. I do not remember the exact figure. Pipe was set in the hole and the pipe was gun perforated and an attempt was made to complete it as a gas well, but gas flowed in considerable volume and was accompanied by some water. So no additional wells were drilled in that area. There are in that area Union Amisk Lake No. 1, which was drilled about 5 miles to the South East and found gas in the same horizon, on the top of the D-2, and for a considerable thickness. Since that date two additional wells have been drilled, Alberta Giant Boyle No. 2 well and another well. To the South East there is Union Amisk Lake Nos. 1 and 2 and Alberta Giant Boyle well. All these three wells got gas in the top of the D-2 and appear to

have the same water level which is encouraging. The total reserve of that area in the Devonian is 25.8 billion cubic feet. In addition to the gas in the Devonian there is also gas in the Lower Cretaceous.

Q There is one other area I would like you to refer to, Wizard Lake. I think it is dealt with at page 40 of your report?

A At the date of this report only one well had been completed in the area, that is, Texaco Wizard Lake No. B-1. That is the discovery well for an important oil field there. Gas was encountered in the Viking and gas and oil in the Lower Cretaceous in the D-2 and D-3. It looks as though that is going to be a very important oil field. It will probably have quite a bit of gas. Our Viking calculation shows an area of 1131 acres with a thickness of 10 feet. The reserves in the Viking are 5.5 billion cubic feet. We have not attempted to calculate the gas in the D-2 or D-3 horizons because we do not have sufficient information on the area, but if that develops into an important oil reserve, which it has every likelihood of doing, there will be important gas reserves in the Wizard Lake area.

Q And that involves the question of solution gas being available for market?

A Yes.

Q Along with oil production?

A Yes. Most of it will be solution gas.

Q That is South West, is it not, of the Leduc Field?

A It is South West of the Leduc field as shown on the map, the index map, which is before page 6. You will notice it is about 8 miles South West of the Leduc field.

MR. C. E. SMITH: Where is that? Oh, I see it now.

MR. McDONALD: Now it is quite a small dot at present. It is due North . . .

A It is in Township 48, Range 27.

Q It is about 6 to 8 miles South of Leduc?

A Yes.

Q Now you have dealt with the prospects in the Edmonton area, Dr. Nauss, at page 64 in your report?

A We have listed here under "Prospects - Edmonton Area". This shows any wells which may develop into important gas reserves, but on which at the present time we do not have sufficient information to make any reserve calculations. But I think these should be pointed out because they might develop into gas reserves in the future. At least some of them will. The first is the Barrhead area. Four wells have been drilled in this area and all four have found gas associated with oil in the Madison. One well, Great Plains Barrhead No. 1 encountered a relatively thin gas cap, which flowed several millions of cubic feet of gas per day on production tests. This is further evidence that the Madison erosional surface is an excellent reservoir for gas.

Now, the Bashaw area. Three wells have encountered large flows of gas accompanied by some oil. These are Transcontinental Westlock No. 1, California Standard Spotted Lake No. 4-21, and American Leduc-Bashaw No. 1. These three wells are shown on the map following page 64. There are good possibilities of gas reserves being developed in this area as associated

and dissolved gas.

Q MR. STEER: Have we got the location of the Barrhead wells shown anywhere?

A Yes, the Barrhead wells are shown on the map following page 25. It is North West of Texaco Majeau Lake.

MR. McDONALD: Did you find it, Mr. Steer?

MR. STEER: Yes, I think so.

Q MR. McDONALD: Dealing with this Bashaw area, is this an oil or gas and oil discovery?

A American Leduc Bashaw No. 1 was an oil discovery in the D-3 and large flows of gas were also encountered. There is a gas cap there apparently and there will be solution gas there. We have no information on how big the field may be but it certainly should be taken into consideration.

Q If so, all problems with regard to production of oil, together with associated gas, will apply to that particular field?

A Yes.

Q I do not know whether it is necessary to go over the other items and prospects in the Edmonton area. Are there any in particular you wish to mention, Dr. Nauss?

A In the Kavanaugh area, which is South East of Leduc.

Q Page 65.

A Page 65. Several wells drilled in this area have found gas and oil in varying quantities from the Basal Quartz or Basal Cretaceous Lenticular Sands. Two wells, Calbrico Kavanaugh No. 1 and American Northland S.E. Leduc No. 1-5-1, set casing through the sands to produce the oil. The operator of Calbrico Kavanaugh set pipe

in an attempt to produce it as an oil well and considered leaving the pipe in the hole to complete it as a gas well. Because pipe was in very short supply he pulled the casing and abandoned the hole. Now, in the American Leduc, which has had a similar history in that they set the pipe in an effort to complete it as an oil well.

Q MR. GOODALL: Do you mean American Leduc or American Northland?

A American Northland, I am sorry. They could not get the oil, they could not separate the oil from the gas on the one hand or salt water on the other, so that well is standing with the casing in the hole and is a gas well. It is a very short distance from the City of Edmonton.

Q MR. STEER: Is there a map showing the location of that? I would like if you would give us the location of each one of these prospects?

A For Kavanaugh you will have to turn to the map just before page 6. The American Northland well is in Township 49, Range 25 and is shown on the map. Section 2, Township 49, Range 25, and Calbrico Kavanaugh is about two miles to the South of that. Both of these are approximately eight miles South East of the South Eastern edge of the Leduc field as shown on the map.

(At this stage there was a short adjournment.)

(Go to page 45.)

MR. McDONALD: Mr. Chairman, it was mentioned it would be helpful to some of the parties if Dr. Nauss would indicate the location of each of those prospects, that is, by township and range. Barrhead, I think, Mr. Chairman, is shown. Possibly to save time if we would make a supplementary page to be distributed and to be inserted with this report.

THE CHAIRMAN: That would be all right.

MR. McDONALD: Would that serve the purpose?

THE CHAIRMAN: Yes.

MR. McDONALD: I am sorry, sir, that our familiarity with these fields has led us to using the names instead of the exact description. They could have been inserted as easily.

Q You mentioned, Dr. Nauss, the Kavanaugh area was due southeast of Leduc and relatively close to Edmonton. That was at page 65?

A Yes.

Q And then you used the sentence, "The area of this predominantly gas pool may be a large one and contribute considerably to Alberta's reserves." And you conclusion, I take it, is that if gas is required for the Edmonton area that this prospect is one that would be canvassed by prospective producers of gas in order to provide any

market that is available?

A Yes, and also it is one in which a number of wells, a large number of wells, are likely to be drilled in the near future.

Q That is, searching for oil?

A Searching for oil, yes.

Q Now, just to indicate the same thought in some of these other prospects, you have Whitemud on page 67. Now, you did not give any estimate of the gas in the Whitemud area. There are several wells there, are there not?

A Yes. The Whitemud is a lower cretaceous oil pool which extends over a small area and is just south of the City of Edmonton, southwest of the City of Edmonton, in Township 52, Range 25, and there are some proved gas reserves there. We left it out because the reserve is small and there is quite a bit of work involved in calculating it.

Q But if anybody required gas that close to Edmonton or wanted to build right to the river bank along where the wells are, that will be an available supply of gas?

A There is an available supply of gas there, yes. The present reserves would amount to possibly one or two billion.

Q MR. STEER: Is it sweet gas?

A I understand it is sweet gas, yes.

Q MR. McDONALD: Now, Dr. Nauss, would you turn to page 68, the prospects in the Calgary area. Now, before you start on that, I thought I would ask - -

MR. STEER: I wonder before you leave those prospects, in the cases where the prospect is indicated on the map, could Dr. Nauss tell us what map?

MR. McDONALD: Right now?

MR. STEER: Right now.

MR. McDONALD: Yes, certainly, if you turn back.

MR. STEER: You have got Barrhead on page 25.

Q MR. McDONALD: Turn to the Edmonton area map next to page 6. Have we Bonnyville located on the Edmonton map?

A No, Bonnyville is off to the northeast of that map, and Brazeau is to the southwest and is not shown, southwest of that map area.

Q The next one is Figure Lake?

A And Figure Lake is shown in Township 62, Range 18, in the Edmonton area just to the south of Amisk Lake northeast of Edmonton.

Q MR. C.E. SMITH: What was the description again?

A 62, Range 18.

Q MR. STEER: West of the 4th?

A West of the 4th.

Q It is on the map, is it?

MR. McDONALD: It is on the Edmonton area map.

MR. STEER: Page 6?

Q MR. McDONALD: Page 6. Kavanaugh we have discussed. Octave?

A Octave, we also pointed that out. That was in Township 49, Range 25, on the Edmonton area map.

Q Pelican-Wabiskaw area?

A There is no map. It is off to the north of this Edmonton area map. However, if you refer to the map on page 2, between pages 2 and 3, the Pelican area is shown on that map.

Q That is Township 80?

A Range 18.

Q Now, Wabiskaw is due - -

MR. STEER: West of - -

Q MR. McDONALD: west of the 4th. The Wabiskaw is due east of that?

A Wabiskaw is southwest of that, a little bit south, mostly west.

Q MR. C.E. SMITH: It is not shown on this map, is it?

A No, it is not.

Q MR. McDONALD: And the Tawatinaw area?

A The Tawatinaw area is shown on the map just before page 6 and it is in Township 62, Range 23.

Q The Wabamun?

A That is not shown, however, the general area is in the vicinity of Lake Wabamun in 53, Range 4, West of the 5th.

Q Wetaskiwin?

A Wetaskiwin is 40 miles south of Edmonton. It is not shown on the map.

Q Whitemud is just west of the City of Edmonton, east of the City of Edmonton.

A Southwest of Edmonton.

Q Willingdon?

A Willingdon is northeast of Joseph Lake. I have not the exact location of that but it is in the vicinity of Township 52 - - oh, let us see, as a matter of fact it is on the map. It is 55, Range 15.

MR. STEER: What map?

MR. McDONALD: On the gas fields in the Edmonton area. Township 55, Range 15.

Q Winnifred?

A Winnifred is southeast of Calgary.

Q Calgary?

A Yes.

Q It is out of place.

A West of Medicine Hat. It is not shown on the map.

MR. C.E. SMITH: Speaking of the Edmonton area?

MR. McDONALD: Winnifred evidently is in the Calgary area.

Q MR. STEER: You have got Sibbald in the Edmonton area too. That is a mistake?

A I do not believe we have it in the Edmonton area, have we?

MR. STEER: On page 2, I think. It is in your detailed examination.

MR. McDONALD: Yes.

MR. STEER: Page 37. I thought you were dealing there with the Edmonton area.

MR. McDONALD: Yes, page 37, Township 28, Range 2. Well, it is on the borderline, I guess.

Q That should be dealt with in the Calgary area?

A It should be dealt with under Calgary area. It is just south of that map.

Q Sibbald? Is there anything further you would like?

MR. STEER: I haven't anything.

Q MR. McDONALD: Now, turning to the Calgary area, Dr. Nauss, you have dealt with the discoveries in the Calgary area in your prospects commencing

at page 68. Now, before dealing with those, there have been other discoveries in the Calgary area which you have not dealt with in detail but you have included them in Plates 2 to 4, 2 to 5.

MR. STEER: Excuse me. Do I understand that the whole of Dr. Nauss's discussion with the Calgary area is done on pages 4 and 5?

MR. McDONALD: Yes, at page 68.

MR. STEER: That is prospects?

MR. McDONALD: Yes.

THE WITNESS: That is right.

MR. McDONALD: And it is a discussion and the comments he will now make with regard to the other discoveries which he has not dealt with in detail.

Q Now, there is addition to Plate - - your original Table "A" and contained in these plates with regard to the southern area, you have the Cessford (Delhi) area?

A Yes.

Q Shown on the Plate 2?

A In the Cessford area and in several other areas, Countess and Craigmyle, we have accepted Delhi's figures. We agree with them and have accepted them in here. We have not made separate and new calculations.

Q So the Cessford (Delhi) in the upper Blairmore you give a net recoverable gas reserve of 76.9 billion; Sunburst

sands net reserves of 43.4; the Cessford (Sunnybrook) in the Viking sands a net recovery of 46.2, Upper Blairmore 51.27, the Sunburst 20.1.

MR. C.E. SMITH: The reference to DeGolyer and McNaughton, that has reference to the brief submitted in the Delhi Hearing, has it?

MR. McDONALD: Yes.

THE WITNESS: Yes.

Q MR. McDONALD: Now, similarly in the Craigmyle area and the Countess area in the Bow Island sand, you have calculated recoverable reserves of 139.5; the Craigmyle area Viking recoverable reserve of 2.6; the Blairmore 27.9 billion cubic feet; Madison 3.7. Now, there is another new discovery in that area, Dr. Nauss, referring to Many Islands on Plate 3, near the bottom?

A Yes. For Many Islands a number of wells have been drilled in that area to the Medicine Hat gas sand.

Q The location is just east of Medicine Hat?

A Just east of Medicine Hat, and is shown on the map, the index map in the front or just after page 2, Township 14, Range 1 and 2.

Q Now, you have taken an area there of 46,000 acres?

A We have taken an area of 46,000 acres, which is the area outlined by the wells that have been drilled within the last six months or so, and our recoverable

reserves are 87.2, and the success of the drilling in that area has been so great that we are confident that the reserves are much larger than that figure but have taken only the area outlined by the wells.

Q I might say, Mr. Chairman, that in many of these instances where we have not submitted the supporting data of drill stem tests and itemized calculations, we would be glad to do so unless it is adequately covered in presentations of other witnesses who will deal possibly in more detail with these particular fields. Now, would you deal now with the further additions that you have, the other addition you have in the south where you have calculated and added to page 5, and that is the Olds, or known as the Bailey-Olds area? That is in your Addenda at page 71.

A During the compilation of this report some of the information on the Bailey-Olds well was made available to us. We still did not have all of it. The Bailey-Olds well is, we believe, an important discovery. The location of it is shown on the map of gas fields of Alberta after page 2.

MR. C.E. SMITH: That is not on the Plate 2 to 4, is it?

MR. McDONALD: No, it is added on the last page, on Plate 5.

MR. C.E. SMITH: Oh, yes, thanks.

MR. McDONALD: It is also covered at page 71, the last page of the report.

MR. STEER: Shown on the map at page -

THE WITNESS: Page 2. The location is in Township 31, Range 27. Bailey Olds #1, recently drilled in Lsd. 2 of Section 18, Township 31, Range 27, West of the 4th Meridian, discovered what appears to be an important new gas field. The gas is present in the Leduc member equivalent of the Upper Devonian formations. On production tests the gas is accompanied by considerable amounts of distillate and has a specific gravity by Pod. of 0.765 at standard conditions and at heating value of 811 B.T.U. per cubic foot.

On production tests the well flowed gas at 12,500 Mcf./day with a back pressure of 2,300 p.s.i.g. and at 26,200 Mcf./day with a back pressure of 1,500 p.s.i.g.

The Petroleum & Natural Gas Conservation Board ran tests for reservoir pressure and temperature, and the results are as follows: Bottom hole pressure 3,320 p.s.i.a., Bottom Hole Temperature 176°F.

According to seismic survey the possible productive area is substantial. However, only 2,000 acres will be considered in the reserve estimate.

The depth of the producing formation, the D-3, is 8,100 feet. You will note that the pressure is quite high, that the reserves per acre are also quite high. We have taken a thickness of 20 feet, and the recoverable gas using 60% recovery is 18 billion. Now, that promises to develop into quite a large gas area, gas reserve.

Q MR. McDONALD: You do not have a basis on which to estimate the area?

A We have no information whatsoever on the area.

Q And your average porosity is 9.9%; did you have information on which to base that or is that your own?

A That is our estimate taken for the D-3 considering that it is D-3 limestone, the nature of the formation.

Q And your connate water at 15% also is based on D-3 information obtained elsewhere?

A That is right.

Q And roughly that well is about 30 miles north of Calgary?

A Yes. It is in Township 31 and Calgary is in Township 24.

Q Now, if you turn to page 68, Dr. Nauss, would you deal with the Okotoks strike, southwest of Calgary?

A Shell Oil Company drilled Shell MacKid #1 in Lsd. 1, Section 19, Township 21, Range 28, West of the 4th, approximately 20 miles southeast of Calgary. That is not shown on any map. The well encountered gas with a

high percentage of sulphur in rocks of Devonian age. Casing was run and perforated. The perforated interval 8490 to 8560 feet was acidized and produced a reported 10,500 Mcf./day with a high Hydrogen Sulphide content. Although sufficient information was not made available to allow a reserve estimate, the gas reserves in this well alone are large. You will notice that that perforated interval amounts to 70 feet.

Q You have no information as to the size of the area of this structure?

A The only information on structure, there is an east-west structure tending through the area that you can see on the surface that extends for many miles. It extends a long way east of the well. The structure as indicated in the surface rock is very extensive but we do not have any detailed information on the seismic maps.

Q Now, if this field was developed it would be a field in which oil and gas were associated?

A There is some distillate in it, I understand. Oil and gas would probably be associated in it, yes.

Q And it is a sour gas field?

A It is a sour gas field. It has a very high sulphur content.

Q Now, deal with the others in this area.

A The Bow Island sandstone, the detrital zone overlying the Mississippian, and the Mississippian, have produced

gas and some oil in this area. However, there is apparently no continuity of the producing formations, and the area has not established any sizeable reserves. The area is near the Alberta-Saskatchewan boundary, a little bit north of Calgary and that far east. It is between Provost and Sibbald.

In the Drumheller area four wells have been drilled to date. As a matter of fact, more have been drilled since this report was written. Naco Drumheller No. 1 is a gas well in the Lower Cretaceous; Naco Drumheller #2 and #3, oil wells in the Lower Cretaceous with a considerable gas cap and dissolved gas reserves; and Dome Naco Drumheller, an oil well in the Nisku equivalent, the D-2 or Nisku. Development in this field may prove large quantities of non-associated and dissolved gas.

Q The location of these wells is about what, about 90 miles east of Calgary?

A It is shown on the map after page 2, the Drumheller area northeast of Calgary. In the Drumheller #2 and #3 wells there is a prominent gas cap above the oil in the Lower Cretaceous.

<u>Turin</u> - two wells, Anglo Calmont G & E Turin #1 and A.G. Bailey Turin #1, drilled in this area, and the area is southeast of Calgary, it is not shown on the map,

it would be about three-quarters of an inch south of that Bassano pool and a little bit west on the map in front of page 3.

Q In the vicinity of Township 15, Range 20?

A Yes, that is the general vicinity. I have not got the exact description.

Q MR. C.E. SMITH: About the "B" in Battery, is that the dope?

A Yes, that is right, a little bit west of that. In this area some oil was encountered, a large volume of gas and some oil in the top of the Madison. The overlying detrital may also be gas-bearing. This could be developed into a sizeable gas field but due to lack of information no reserves can be calculated.

Now, the Bassano area is in southern Alberta some 75 miles southeast of Calgary. Several deep tests have been drilled and some gas has been encountered in the Cretaceous and Mississippian formations. However, efforts to produce the gas have been unsuccessful. In a thing like that it may be on the edge of the gas pool and they may be able to get greater thicknesses going up-dip. A lot of those prospects which have encountered some gas in which the gas is non-commercial might be better up-dip. They might be just on the edge of the gas pool.

At Didsbury the Canadian Superior of California found gas and oil in its Robertson #9-26 located in Lsd. 9 of Section 26, Township 30, Range 3, West of the 5th. That is north and a little bit west of Calgary. It is west of the Olds field. The reservoir for the gas is the Madison formation of the Mississippian period. The Madison was acidized and on production tests produced 2,604 Mcf./day with 36 barrels of light crude. Sufficient information is not available to allow reserve estimates, but the gas reserves are probably considerable.

(Go to page 60)

Q MR. McDONALD: That field, ifdeveloped, would be an oil and gas field?

A Yes, in view of the fact that light crude is produced here. In fact,you could not produce oil without a market for the gas.

Q Now, if you will turn to the Peace River area at page 41 of the report?

A The Peace River area is of vital importance to any discussion of the gas reserves of the Province. Exploration and drilling to date have covered only a small percentage of the area, and yet the number of discoveries on a per well wildcat basis is substantially above the average of the rest of the Province. In the past six months new discoveries have been coming in at the rate of almost one per month - including

Tangent
Little Smoky
Belloy
Spirit River

and the Sunrise field in British Columbia.

Any acceleration of the rate of exploration under such an incentive as export would undoubtedly produce proportionately greater results, with the added benefit of oil discovery as well.

As will be seen below, the general geology of the area is extremely favourable to gas and oil accumulations, and will, with the proper amount of exploration and development, produce gas and oil fields of great size and value both to the Province and the Dominion.

Under the circumstances, a summary of the history of drilling in the area, its stratigraphy, and a discussion of the possibilities for the discovery of additional gas fields is included in this report in order to provide a background to this important region.

Q The next page contains a map showing the wells drilled, running from Township 72 in the south to Township 86 in the north, and Range 19, West of the 5th on the east to Range 8, West of the 6th on the west.

A Yes.

Q On page 42 you have a summary of the history of drilling in the Peace River area. I think that has already been placed before the Board in one of the other reports?

A Yes.

Q And then at page 43, and pages 44, 45 and 46 you discuss stratigraphy.

A Yes.

Q I wonder if you would now deal with the plate, the stratigraphic column of the Peace River area which follows page 43?

A On this column we have attempted to show graphically the section in the area together with - on the lefthand side of the column we have shown a gas symbol there indicating where gas shows have been encountered, and also commercial quantities of natural gas. The first formation, the Dunvegan, at the top, is a sandstone, and small shows have been encountered in that formation but to date no commercial gas has been developed. The next symbol down is in the Cadotte sandstone, which is in approximately the same horizon as

the Viking in this part of Alberta, and several important gas discoveries occur in that sand, the Pouce Coupe field, the Sunrise field, and several of the other fields are in that particular sand.

Very important gas shows have been found in the Notikewin and the Monias sand, and then the Gething in the Lower Cretaceous is a very important gas horizon. The wells at Tangent are completely in the Gething. There is also important gas in the Gething at Whitelaw and at Belloy - excuse me, at Spirit River.

And then there are two symbols shown in the Triassic. Those are the approximate horizons of the Whitelaw wells. The Whitelaw wells have the most important gas reserves in the Triassic.

Then in the Permo-Pennsylvanian, the Whitelaw No. 1 well encountered oil in the Permo-Pennsylvanian.

Some gas shows have been encountered in the top of the Mississippian, and the Belloy occurrence is in the top of the Mississippian.

Gas shows have also been found in the D-1 area, which is the Wabamun. That is the second gas symbol from the bottom.

And then the Normandville pool produces from the Woodbend formation, and the Leduc member. That is the last symbol at the bottom of the chart, the last gas symbol. The sections consist of interbedded limstones, sandstones and shales. There are a lot of pinchouts in the area, and gas has been encountered in quite a number of different porous horizons indicating

that the area is attractive, has attractive possibilities for gas throughout a great thickness of section.

MR. SMITH: Will you relate your thickness figures, Mr. McDonald, to these columns?

Q MR. McDONALD: Mr. Smith would appreciate it, Dr. Nauss, if you would do that? When you take 600 plus or minus, just what does that mean?

A The thicknesses refer to the - you will notice on the righthand side there is a symbol?

Q MR. SMITH: An extension?

A An extension, yes. And the thicknesses end at those lines on the righthand side. The 600-foot thickness is at the bottom of the Dunvegan, and the 750 is from the top of the Shaftsbury to the bottom of the Cadotte, and so on.

Q MR. McDONALD: These do not mean that is the depth of the wells, at all?

A Those are the thicknesses of those formations and groups of formations.

Q When they are encountered, this is an average thickness?

A That is correct.

Q Throughout the area?

A As a matter of fact, those thicknesses vary greatly. A number of those formations pinchout completely as they go eastward, northeastward.

Q I see.

Q MR. STEER: They are obviously not to scale?

A I beg your pardon?

Q They do not seem to be to scale?

A No.

Q MR. SMITH: Taking the 400 and the 950?

A The 950 is for the entire Peace River series.

MR. STEER: Therefore they are not supposed to be to scale, Mr. McDonald, are they?

MR. McDONALD: No, they are not to scale.

A They are not to scale, it is a sketch.

Q They show the depth of these formations where they have been encountered, plus or minus in each instance. There is a discussion here of the individual formations on pages 43, 44, 45 and 46.

A Yes.

Q Now, we come to page 47, Dr. Nauss. It is headed "Discussion", and would you read your discussion?

A One in four of the recent wells drilled in the Peace River area have been completed as gas wells. This remarkably high average indicates that this region is good gas territory.

The geologist would arrive at the same conclusion from a study of the stratigraphic section. There is a thick section of interbedded marine sandstones, shales and porous limestones with numerous unconformities and pinchouts. More formations are present in this area than in the plains area to the southeast, so that a wildca well has more prospective producing horizons to explore.

In the Edmonton area, gas horizons are indicated in the Viking sand of Upper Cretaceous age; the Lower Cretaceous sands; and the Upper Devonian reef limestones and dolomites. In the Peace River area the gas horizons are the Dunvegan and Cadotte sands of Upper Cretaceous age; the Notikewin, Monias and Gething sands of Lower Cretaceous; the Triassic sandstones, the Permo-

Pennsylvanian sandstones and dolomites, the Mississippian and Devonian limestones and dolomites. In other words, in parts of the Peace River area there are seven geological ages which contain rocks which are potential gas horizons, while in parts of the Edmonton area there are only three.

These statistics and geological data seem to indicate that the Peace River area is a better "hunting ground" for gas than other parts of Alberta, and when the exploratory efforts in this area become comparable to that of other parts in Alberta, the possible future gas reserves should be greater per square mile in the deeper portions of the Peace River area.

Stated in another way, the discovery of natural gas and oil reserves is almost directly related to the number of holes drilled and the prospectiveness of the area. The Peace River areas of Alberta and British Columbia are excellent prospective areas and a continuance of the present rate of exploration will undoubtedly result in the proving up of large reserves. However, if an incentive for drilling of development wells is provided by some assurance of a market for the gas developed, more than adequate reserves for an export pipeline will be proved up in a very short time.

Q Now, would you deal with the occurrences of the fields which you have included in your calculations, starting at page 50, taking the Little Smoky Lake first?

A Little Smoky Lake, a map of that follows page 50. Four wells have been drilled in the general area and only one encountered commercial amounts of gas. Imperial Little Smoky #1, the discovery well, found gas in the Gething

formation. The follow-up wells have limited the size of the field although they have not found its boundaries. The drillstem tests are listed on page 50. The first drillstem test was in the top of the Cadotte and had just a small show, a small gas flow of 800 cubic feet per day. However, there was 360 feet of water. Then three other drillstem tests were taken, the first one being from 3090 feet to - in the interval from 3090 to 3100, and gas flows ranged from 8 million to 10 million cubic feet per day Salt water was encountered in the test from 3136 to 3187. The electric log shows a net gas pay of 10 feet. We have taken an average thickness of 8 feet over 1250 acres to give us a recoverable gas reserve of 5.8 billion cubic feet. The average thickness is less. We have assumed the average thickness would be less than the thickness in the discovery well.

Q DR. GOVIER: Dr. Nauss, was the Gething sand present in the Pacific Little Smoky Lake #1 well?

A I beg your pardon?

Q Was the Gething sand present in the Pacific Little Smoky well?

A The Gething sand was present but they obtained no gas.

Q The Gething sand was present but they obtained no gas?

A No.

Q MR. SMITH: On here you show that you take 1250 acres rather than 2000 that you have used sometimes?

A We have taken 1250 acres. You cantake it at 2000 acres if you want to.

Q I do not want to. I was just wondering where our 2000 acres went to, because I notice in this you use 1250 acres,

and I just wondered if you would explain it?

A The surrounding dry holes indicate the area is limited, although there is ample space in there for a lot more acreage than we have indicated.

Q MR. McDONALD: You would like another well drilled before you extend it beyond 1250?

A Yes, and the wells do indicate that the area is limited.

Q And then if you will turn and deal with Spirit River. Spirit River is what I have referred to as Dunvegan at times, and is that the same general area?

A Spirit River is known under three different names, Dunvegan, Spirit River, and Hamlin Creek. This is a Texaco Hamlin Creek well.

Q Have you got a map that will show that?

A The map between pages 41 and 42 shows tbe Hudson's Bay well in Township 80, Range 6.

Q Range 6, West of the 6th?

A Yes. The Hudson's Bay-Union-Texaco-Spirit River No. 1, still drilling at the time this report is being written, encountered large flows of gas from the Cadotte and Gething as well as gas and oil with salt water in the Triassic.

Drillstem tests are listed in this well. You will note that the top of the Cadotte was tested, and the top 18 feet produced 2,214,000 cubic feet per day, and 20 feet of mud. They went ahead and tested another 10 feet and obtained 403 MCF and recovered 207 feet of salt water. In other words, the gas/water contact is in that second drill stem test. The next series of tests was in the Gething, the top of which was encountered at 3170. The Gething is interbedded sandstone and shale,

so the first test is well below the top of the Gething. From 3271 to 3305 they obtained a gas flow of 7,000,000 cubic feet per day, and went on down to 3340 feet, which is 70 feet lower, before encountering salt water, and on that test it obtained some oil, a small amount of oil, and then continued on down and in another sand in the Gething from 3435 to 3450 they obtained 5000 MCF per day, but that test was of a 15-foot interval. And in tne next test below, which was a 47-foot interval, they obtained 850 feet of salt water. The electrolog shows a net gas pay of 20 feet in the Cadotte, 39 feet in the first Gething gas sand, and 13 feet in the second Gething gas sand.

The gas reserves in the Cadotte, using an average thickness of 15 feet, and an area of 10,000 acres, and that area was taken from a report by the Hudson's Bay Company, and they obtained that from their structure maps of the area, using the area from their report and that thickness, you get a gas reserve of 36.9 billion cubic feet in the Cadotte. In the Gething, the first sand, using the same area, 10,000 acres, and 30 feet, I am sorry, this is in both sands, the two Gething horizons added together, using a thickness of 30 feet, and the electrolog shows on the one well a thickness of 52 feet altogether, but we used an average thickness of 30 feet over the 10,000 acres, and the gas in place is 186 billion cubic feet and a recoverable gas of 149 billion.

A Yes, I was just going to ask you, Dr. Nauss, in view of the drillstem tests, would you anticipate a large open flow from this type of well?

A Yes, considering those high flows on the drillstem tests

and the high reservoir pressure.

Q The reservoir pressure is?

A 1140 pounds. So that there will be a large open flow.

Q That is in the Gething?

A Yes.

Q 1140 pounds in the Gething?

A Yes.

Q And the average porosity of 22%, connate water of 25%, do you consider those conservative estimates?

A Those are the estimates what we think it will be, close to what we think it will be.

Q MR. SMITH: Were you assisted with information from Hudson's Bay on those two items, or not?

A Not on those two items, no.

Q DR. GOVIER: Dr. Nauss, could you indicate on the Peace River area map just where this 10,000 acres is?

A I have not seen the Budson's Bay Company map and I have taken their figures from their report. I understand they are going to present that here.

Q All right.

A The Sunrise area in British Columbia. Pacific Petroleums Limited has accomplished an extensive drilling program in this area, and has outlined some gas reserves. Eight wells have been drilled and, of these, two encountered commercial amounts of gas. A third found small amounts of gas and has assisted in establishing the reserves.

Pacific Sunrise No. 3 well, the drillstem tests are shown there. The gas flows are not large. They are around 1,000,000 cubic feet per day, and

here the producing formation is the Cadotte, the Cadotte sandstone. The net thickness of gas sand in the Pacific Sunrise No. 3 is 26 feet, and the average porosity of that 26 feet is 21% as determined by core analyses.

Pacific Sunrise No. 6, the net thickness is 30 feet in that. Pacific Sunrise No. 4, the drillstem tests are listed. You will note that the tests vary from 90 MCF to 400 MCF per day. One drillstem test at 3112 to 3137 gave a gas flow of 1170 to 1090 MCF per day.

A calculation of the gas reserves in those three wells, using an average thickness of 25 feet over an area there of 3800 acres, is 21.5 billion cubic feet.

In the Tangent area four wells have been drilled in this area to date. These are: Imperial Tangent, which was abandoned, and these wells are shown on the map in front of page 42; Hudson's Bay-Union Tangent No. 1 which blew out and was closed in. After several months of blowing wild it was closed in. Then Hudson's Bay-Union Tangent No. 2 which found gas in three horizons, the Cadotte, the Gething and Triassic. And then the Hudson's Bay-Union No. 3 which found gas in the Cadotte and Gething.

Now, since this was written, another well, the Hudson's Bay-Union Tangent No. 4 was also completed as a gas well, considerably enlarging the area.

Q MR. SMITH: Can you locate that for us, Dr. Nauss?

A Those wells are shown on the map in front of page 42 in

Township 80, Ranges 23 and 24. Now, the fourth well is several miles northwest of this P.R.N.G. Brownvale well, and it is also a gas well.

In the first well there, the first drillstem test, 1152 to 1170, that was in the top of the Cadotte, there was a gas flow of 852 MCF per day, and it recovered 315 feet of mud. The second drillstem test was misrun, and they did not test any more in the Cadotte. However, in the top of the Gething, from 2403 to 2430, they obtained a gas flow of 3,503,000 cubic feet per day. The next test was from 2841 to 2893 in the Triassic where they got 348 MCF per day. The well blew out and later was closed in.

The No. 2 well was drilled in the next section to the east, and the drillstem test is shown at the top of page 56. In the top of the Cadotte they encountered gas. They encountered gas again at the top of the Cadotte of 400 MCF per day, and in the Gething, in the top of the Gething, theyalso had gas on two drillstem tests. The electric log of this well shows 18 feet net gas pay in the Cadotte, and 22 feet in the Gething, with 12 feet in the Triassic.

The third well was drilled in Section 25 of the same Township, which is to the south of the No. 2 well. It is to the southeast, as a matter of fact. The drillstem tests are listed in the Gething. In the Cadotte they did not get a prominent, they did not get any gas, but it was not well tested. The only successful test was from 1138 to 1149, and they got 180 feet of slightly oil-cut mud, so the results of those drillstem tests there

suggests that it was not well tested.

In the top of the Gething, the same Gething sand, they got a gas flow of 2204 MCF, and a salt water spray in 25 minutes. In the Triassic they recovered no gas.

The casing was gun-perforated from 1138 to 1150 feet, where those drillstem tests were run, and that produced 4170 MCF there through tubing. They took three drillstem tests in the zone, failed to find any oil and completed it as a gas well with 4,170,000 cubic feet per day.

(Go to page 73).

Now, a fourth well has been drilled to the North West, 7 miles to the North West, further extending the area. We have not got the results of that.

Q MR. C. E. SMITH: What is the name of that, Doctor?

A It is Hudson's Bay Union Tangent No. 4. The calculations of gas reserves are shown here. We have taken an area of 22,000 acres, that is taken from a Hudson's Bay report, and they have taken the area from their structure map, which was not available to us. It is confidential information and was not made available to us. There is very good evidence of a continuity between the wells that have already been drilled but the wells alone would not prove 22,000 acres. We have taken an average thickness in the Cadotte of 20 feet and that gives a gas reserve of 67.7 billion cubic feet.

Q MR. McDONALD: Of recoverable gas?

A Of recoverable gas. In the Gething, using a thickness of 19 feet for the same 22,000 acres, you get recoverable gas of 120 million cubic feet and in the Triassic the thickness is considerably less and would not extend over the entire closure area. We have taken an area of 11,000 acres in the report and that gives a gas reserve of 39.6 billion recoverable gas reserves. The total gas reserves in the Tangent area for the Cadotte, 67.7 billion; the Gething, 120 billion and the Triassic, 39.6 billion, giving a total of 227.3 billion cubic feet. Now, we come to the Valleyview. Pacific Petroleums Limited have drilled two wells in the Valleyview area which have encountered gas, Pacific Valleyview

No. 1 and No. 2. The wells are too far apart to be considered to lie in the same gas pool. They are about 3 or 4 miles apart. This area is shown on the map. Pacific Valleyview No. 3 is in Township 72, Range 22 and Pacific Valleyview Nos. 1 and 2 are immediately to the South of that.

Q MR. C. E. SMITH: They are not marked on the map?

A They are not marked on the map, no. It is off the map area.

Q MR. McDONALD: You have calculated Valleyview No. 1?

A Yes, Valleyview No. 1 was presented in our previous report and the recoverable reserve is 10 billion cubic feet, which shows in that report. The No. 2 well encountered gas in the same horizon and the factors used have been the same. The net gas pay is 7 feet and the productive area is a thousand acres for the second well. Gas in place is 4.4 billion and the recoverable gas 3.5 billion. The total gas in place for the Valleyview area is 16.9 billion cubic feet and the recoverable reserves are 13.5 billion cubic feet. That is an addition of 3.5 billion cubic feet over our previous estimate, due to the drilling of the second well.

In the Normandville area, which is shown on the map, Imperial Normandville No. 2 located in Legal Subdivision 10, Section 20, Township 79, Range 22, that is North West of the No. 1 well, a short distance North West of the No. 1 well, it encountered gas in the Gething, which was also gas-bearing in Normandville #1. This causes an upward revision of the gas reserves for the Normandville

area from 13.4 billion cubic feet to 32.2 billion cubic feet and the recoverable gas from 10.7 to 25.8 billion cubic feet, due to the drilling of that second well.

Q That is gas that is not associated with oil to which you are referring?

A That is right, that is in the Lower Cretaceous.

Q There is gas associated with oil in the Devonian formations?

A In the D-3 but we have not calculated that gas because the proved volume is very small at the present time. The proved acreage for those two wells is 4816 acres.

Q DR. GOVIER: How far apart are those two wells, Dr. Nauss?

A They are a little more than a mile. I have not got the location of the second.

Q No. 1 is located on the map?

A No. 1 is located on the map, and the No. 2 location is Legal Subdivision 10 of Section 20. If you plot that on the map you will see that it is about two miles North West. Now Whitelaw. Since the original Whitelaw gas and oil discovery, 5 wells have been drilled. 3 of these encountered gas in volume and 2 have been abandoned. The structure of the field has not been outlined by drilling to date. In our previous report we gave the data on the No. 1 well listed here as data on Shell - B.A. Whitelaw No. 2. The top of the Triassic was encountered at 3288 feet and the top of the Gething was encountered at 2825 feet. The first six tests are in the Gething and you will note the first test had 200 Mcf, the second test 10 Mcf and the important gas sand was encountered in the tests at 2870 to

2915, an interval of 45 feet. The gas flow was 2 million cubic feet per day. The second test in that sand from 2913 to 2945 gave a gas flow of 500 Mcf per day and the third test in the sand from 2945 to 2980 gave a gas flow of 124 Mcf per day, and recovered 124 feet of watery mud. The last test in the sand from 2986 to 3055 gave no gas and recovered 540 feet of salt water, showing that the gas-water interphase is between 2980 and 2986. The drill stem tests in the Triassic are listed from 3231 on down. This second Whitelaw well is South of the No. 1 well. It is about a mile away. It also got gas but in one of the important sands got some salt water from 3327 to 3362. There was a gas flow of 1140 Mcf per day and they recovered 700 feet of salt water. Now, that test was for an interval of 35 feet and it included a sand which contained gas in the No. 1 well and it shows that this well is near the water level in that particular sand. But they went down below and got some more gas. In the Permo Pennsylvanian, 3840 to 3850, which was about 4 feet in the top of the Permo Pennsylvanian, they got a gas flow of 1540 Mcf with 130 feet of salty sulphur water. That showed that the gas thickness of the Permo Pennsylvanian was so insignificant. However, it just points to the possibility that somewhere in that field you may get a free gas cap in the Permo Pennsylvanian, which is the horizon in which they found oil in the No. 1 well. The well was gun perforated from 2824 to 2833 and from 2895 to 2940 and these are in the Gething. On a production test from a half-inch choke it gave 2470 Mcf per day. The net gas pay in the Gething is 18 feet,

which includes the upper and the middle Gething sands. Using an average thickness of 15 feet over an area of 1260 acres around that well, you have a gas reserve of 8.8 billion cubic feet in those two sands.

(Go to page 78.)

A The No. 3 well was drilled on the northwest of the No.1 well and the drill stem tests are listed there. The first four tests in the Gething formation, you will note that they obtained flows of from 550 Mcf. per day to 758 Mcf. per day, and in the last, in the test from 2976 to 2999 they obtained 550 feet of muddy salt water, showing that the gas-water interface is probably above 2976. The test there in the Triassic and Permo-Pennsylvanian indicate that those formations are water-bearing so that limits the field to the northwest. The formation was penetrated, the Gething was penetrated from 2960 to 2974 and also from 3025 to 3055, that was in the two Gething sands. The middle Gething sand has a net pay thickness of 13 feet. Using an average thickness of 10 feet the recoverable gas is 3.5 billion cubic feet. The data on the Bluesky well, the first test, was in the Gething. The first test there is in the Gething and they obtained a gas flow of 4520 Mcf. per day and recovered 350 feet of mud. There was a high chloride content. The second test from 2754 to 2769, also in the Gething, they recovered 580 feet of salt water, indicating that they had got into the water level, so that the water level is 19 feet below the top, around 19 feet below the top of that sand. They went ahead and tested the Triassic and obtained these two gas tests from 3114 to 3211 and

they got 650 Mcf.; from 3199 to 3226 they got 1248 Mcf. per day. The subsequent test showed the absence of commercial amounts of gas in the remainder of the Triassic and Permo-Pennsylvanian. The perforations were in the top of the Gething and in the Triassic. After being acidized with 6,370 gallons through the three lower sets of performations, those are in the Triassic, the Triassic flowed gas at a maximum rate of 1615 Mcf. per day with a half-inch bottom choke. The open flow obtained in the Gething sand is about 14 million per day.

Q Was that taken by tests through tubing?

A The Gething test?

Q Yes?

A I think they were taken through tubing, yes.

Q That compares to your open flow of 4520 Mcf. per day by drill stem tests?

A Yes. 4520 Mcf. per day was the highest, was the flow they obtained in the drill stem tests in the Gething.

Q But on tests after casing perforation it produced 14,000 Mcf. per day?

A That is right. The electrolog indicates the net gas pay of the Gething is 12 feet and of the Triassic 13 feet. For the Gething an average thickness of 8 feet over an area of 1280 acres was taken to get a gas reserve of 4.7 billion cubic feet. Now, in the Triassic,

as indicated by those drill stem tests, three wells have been completed as successful gas wells. The Whitelaw No. 1 well encountered the greatest thickness in the Triassic, the Whitelaw No. 2 well and the Bluesky No. 1 well. In the Whitelaw No. 3 well the drill stem tests in the Triassic were inconclusive and there was a possibility that the gas area could extend as far northwest as Whitelaw No. 3 well. However, no gas was obtained nor was salt water obtained. No salt water was obtained in the upper 100 feet or so of the Triassic, so there is a possibility that even in that well there is some gas.

We have taken an area of 10,480 acres which includes those three wells. That area does not extend as far north as No. 3 well, however. An average thickness over that area of 60 feet, and the recoverable gas is 320 billion cubic feet. The total gas reserves of the Whitelaw area are tabulated there, in the Gething in Shell-B.A. Whitelaw No. 2, 8.8 billion; for the middle Gething in the Shell-B.A. Whitelaw No. 3 well, 3.5 billion; for the Bluesky well, Gething, 4.7 billion, and for the Triassic, Whitelaw No. 1 and No.2, and the Bluesky No. 1 well, 320 billion, giving a total of 337.

Q DR. GOVIER: How did you arrive at the acreage figure, Dr. Nauss?

A The acreage figure? We took all of those three wells as being within the one pool and took an area extending to about a mile on either side of the well, of all those wells.

Q Is this the same acreage you have in your previous submission?

A Yes, that is the same acreage we had in the previous submission except that in that one - - it is not the same acreage as we had in the previous submission to this Board, no, it is larger.

Q Did you have any seismic data to aid you in that?

A We had the seismic map but the seismic map gives very little information on the area.

Q MR. McDONALD: You have made some changes in your calculations. In your previous submission the porosity in the Whitelaw No. 1 was 170 feet, the thickness of the porous zone of which 170 feet is porous?

A Yes, we have taken the average thickness over the whole area as 60 feet in this submission.

Q And that is the minimum thickness as shown in any of the wells drilled?

A No, it is the average thickness over the area. The Bluesky well had a smaller thickness than that. At the

time of our previous submission we did not have all the data on Bluesky No. 1 well, you will recall.

Q At page 5 of your report you have summarized the total of the recoverable reserves in the Peace River area dealing with the fields that you have discussed?

A We have not discussed the Belloy field.

Q At page 70 you have an addenda, have you not?

A Yes. Yes, the information on the Belloy field came in after the completion of this report, and the location of that well is in Lsd. 4, Section 20, Township 78, Range 1.

Q That is at page 70?

A Yes, page 70.

Q Yes, and the location would be shown?

A On the map.

Q The map at page 42?

A The Belloy No. 2 well is plotted on that map. It is Township 78, Range 1, West of the 6th. It is about four miles northwest from Imperial-Belloy No. 1 which was completed as a dry hole. It encountered large amounts of gas in the Nikanassin sand and also in the Mississippian. Although sufficient data is not yet available to accurately calculate the reserves, the following is our estimate of the reserves based on comparison with other fields of similar types. The Imperial Oil gave

us an area of 9,000 acres as being the area of the seismic anomaly. Assuming an area of 9,000 acres and using a thickness of 20 feet, recoverable reserves per acre of 500 Mcf. We do not have the details which are necessary in a reserve calculation to calculate the reserves per acre foot so we have taken 500 Mcf. by comparing it with similar fields at that depth. That gives you about 90 billion cubic feet of reserve in place with 72 billion recoverable.

Q Just where do we get the Nikanassin sand? Where does it stand on your stratigraphic column?

Q MR. C.E. SMITH: Where do they get that from?

A There is a river by that name, Nikanassin.

Q MR. McDONALD: Is it Lower Cretaceous?

A It is in the Lower Cretaceous.

Q Would you mark it?

A It is not marked in there, no.

Q Where does it lie?

A It is an isolated sand within the Lower Cretaceous.

Q THE CHAIRMAN: Dr. Nauss, this figure of 9,000 acres on one well, were those sands present in the Belloy-Imperial No. 1, which is roughly three or four miles - -

A The Madison was present in the No. 1 well, yes. This

is for the Madison, you see.

Q You say you base your figure of 9,000 acres on Imperial Oil?

A We got the figure of 9,000 acres from Imperial Oil. I have not seen their map, it was not available.

Q MR. McDONALD: The reserve is in the Madison formation?

A That is correct.

Q Would oil be produced along with the gas in this particular area, do you know?

A I understand that there has been some oil in the Madison but I have no confirming data on it.

(Go to page 85)

MR. McDONALD: With regard to this field, Mr. Chairman, we would be glad to submit a calculation, together with the details of the other fields as soon as it is available to us, but we thought in view of the importance of the strike and the reports that were made with regard to it, that it was worth adding at this time.

Q Are there any other fields that you want to discuss in the Peace River area, Dr. Nauss? I think you have covered them all?

A I think that is all.

Q So as shown on page 5, a report of the total Alberta reserves, recoverable reserves, you have made an estimate of 980.3 billion cubic feet, to which can be added the estimates in the British Columbia fields, on the British Columbia side, the Pouce Coupe field, and the adjoining or closely adjacent Sunrise field, to give you a total of 1 trillion, 26.9 billion cubic feet. The Pouce Coupe field, is reported in your previous submission, Exhibit J-29, filed in the Joint Hearing on November 8th, 1950?

A Yes. We did not revise the reserves of the Pouce Coupe field.

Q Now, Dr. Nauss, to attempt to explain further your estimates, as I take it, your Tables 2, 3, 4 and 5 contain the engineering data, contain your judgment as to the areas involved, and contain your estimate of recoverable reserves in regard to the fields in the Province which you have calculated?

A Yes.

Q Now, your reports, that is, the two previous ones and this one, contain the references to the individual wells, the

legal description of where they are situated, and all of the relevant data which you could obtain in regard to them, including the drillstem tests, pressures, temperatures, etc.?

A Yes.

Q Now, do you agree that your Tables 2, 3, 4 and 5, with all of the other data submitted, comprise your total report?

A Yes. In this report we have not repeated information previously given at these hearings, and this report may be considered as a supplement to all the previous reports that we have made.

Q Now, you have submitted to the Board in these reports, drillstem tests and the actual levels that you have of the presence of gas in all these fields as far as you are able to obtain it?

A Yes, that is right.

Q In many instances you added electrologs?

A Yes.

Q Now, you have used the words "recoverable reserves" here. We have had discussions previously with regard to proved, probable and possible, I was wondering if you would just again outline to the Board as to your meaning and what you have in mind in this estimate of recoverable reserves as it is related to the problem?

A We have included here what has been classed as proved and probable under this one heading of recoverable reserves. There is no sharp distinction between proved and probable. As a matter of fact, the ability to accurately calculate reserves depends on the data available, and the data on one field might be quite accurate and on the next field a

little less accurate and so on. There is a complete gradation in the amount of information that you have from the field in which you have most information to that field in which you have almost no information. We do not feel,though, that there was any sharp line between proved and probable, so we have included both proved and probable reserves in this one Table. In regard to possible reserves or potential reserves, we have not placed any figure on potential reserves, because those reserve estimates that we classified as potential are so poorly supported by data that to put a figure on those potential reserves would be too much of an approximation and the figure would not mean very much. We prefer to make the simple statement that Dr. Hume made, that the potential reserves of the Province are many times,are probably many times the proved and probable.

Q That is all the direct examination, sir.

THE CHAIRMAN: We will adjourn until tomorrow.

MR. McDONALD: Before you adjourn, sir, if I might be permitted to do this, I have this submission by Dr. Hetherington entitled "Plan to Supply the Future Requirements of Canadian Western Natural Gas Company Through Limited Export", and I would like to distribute it, if I may.

THE CHAIRMAN: Yes.

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(Hearing adjourned until 9.30 A.M. September 11th, 1951)

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